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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/975,639	10/11/2001	Patricia B. Smith	TI-29811	8363
23494	7590	10/01/2004	EXAMINER	
TEXAS INSTRUMENTS INCORPORATED			HOANG, QUOC DINH	
P O BOX 655474, M/S 3999			ART UNIT	
DALLAS, TX 75265			PAPER NUMBER	
			2818	

DATE MAILED: 10/01/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

09/975,639

Applicant(s)

SMITH ET AL.

Examiner

Quoc D Hoang

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 07 July 2004.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1,5-13,30-39 and 51-68 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 51-59 is/are allowed.
- 6) ☒ Claim(s) 1,5-13,30-39,60-68 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Response to Amendment*

1. Amendment filed on 07/07/2004 has been entered and made of record as Paper No. 0704. Claims 1, 5-13, 30-39 and 51-68 are pending in the application.

Applicants' remarks have been considered.

### *Claim Rejections - 35 USC § 102*

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 30 and 60 are rejected under 35 U.S.C. 102(e) as being anticipated by Kropewnicki et al( US Pat 6,440,864).

Regarding claim 30, Kropewnicki et al., Figs. 1-6, and related text on col. 1-14 which discloses a method of fabricating an electronic device formed on a semiconductor wafer 35, comprising the steps of: forming a layer of a first material 45 in a fixed position relative to the wafer 35 (col. 5, lines 60-67 and Fig. I A); forming a photoresist layer 50 in a fixed position relative to the layer of the first material 45 (col. 3, lines 35-55 and Fig. I A); forming at least one void 55 through the layer of the first material 45 in response to the photoresist layer 50, wherein the step of forming at least one void 55 further forms a polymeric residue 60 in response to the photoresist layer 45 (col.3, lines 35-55 and Fig.

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1A); subjecting the semiconductor wafer 35 to a plasma which incorporates a gas which includes hydrogen so as to remove the photoresist layer 50 (col. 6, lines 10-65); and removing the polymeric residue 60 by subjecting the semiconductor wafer 35 to a wet etch chemistry (col. 1, lines 20-60).

Regarding claim 60, Kropewnicki et al., Figs. 1-6, and related text on col. 1-14 which discloses a method of fabricating an electronic device formed on a semiconductor wafer 35, comprising the steps of; forming a layer of a first material 45 in a fixed position relative to the wafer 35, wherein the first material 45 has a dielectric constant less than 3.6 (col. 5, lines 60-67 and col. 8, lines 1-31 and Fig. I A); forming a photoresist layer 50 in a fixed position relative to the layer of the first material 45 (col. 3, lines 35-55 and Fig. I A); forming at least one void 55 through the layer of the first material 45 in response to the photoresist layer 50, thereby forming a polymeric residue 60 in response to the photoresist layer 50 (col.3, lines 35-55 and Fig. I A); and subjecting the semiconductor wafer 35 to a plasma which incorporates a gas which includes hydrogen so as to remove the photoresist layer 50 (col. 6, lines 10-65); and removing the polymeric residue 60 comprises subjecting the semiconductor wafer 35 to a wet etch chemistry (col. 1, lines 20-60).

### ***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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5. Claims 1, 5-13 and 31-39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kropewnicki et al ( US Pat 6,440,864) in view of Torek et al (U.S. Pat 6,562,726).

Regarding claim 1, Kropewnicki et al., Figs. 1-6, and related text on col. 1-14 which discloses a method of fabricating an electronic device formed on a semiconductor wafer 35, comprising the steps of; forming a layer of a first material 45 in a fixed position relative to the wafer 35, wherein the first material 45 has a dielectric constant less than 3.6 (col. 5, lines 60-67 and col. 8, lines 1-31 and Fig. I A); forming a photoresist layer 50 in a fixed position relative to the layer of the first material 45 (col. 3, lines 35-55 and Fig. I A); forming at least one void 55 through the layer of the first material 45 in response to the photoresist layer 50, thereby forming a polymeric residue 60 in response to the photoresist layer 50 (col.3, lines 35-55 and Fig. I A); and subjecting the semiconductor wafer 35 to a plasma which incorporates a gas which includes hydrogen so as to remove the photoresist layer 50 (col. 6, lines 10-65); and removing the polymeric residue 60 comprises subjecting the semiconductor wafer 35 to a wet etch chemistry (col. 1, lines 20-60). Annealing after a wet etching to evaporate/remove the etchant solution remaining on the surface of the wafer. At the time of the invention was made, it would have been obvious to a person of ordinary skill in the art to perform an annealing step because it would remove the etchant solution that could contaminate the wafer.

Regarding claims 7-13 and 31-34, Kropewnicki et al., discloses removing the polymeric residue by using a wet etch chemistry but do not disclose the combination of dilute hydrofluoric acid and an organic acid.

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However, Torek et al discloses removing the polymeric residue 40 by using a wet etch chemistry comprises subjecting the semiconductor wafer to a combination of dilute hydrofluoric acid and an organic acid, wherein the organic acid comprises diluted citric acid, diluted acetic acid or diluted oxalic acid at 0.0001% to 1.0%, and wherein the dilute hydrofluoric acid at 0.01% to 5.0% (col. 6, lines 1-46 and Fig. 4). At the time of the invention was made, it would have been obvious to a person of ordinary skill in the art to combine the combination of dilute hydrofluoric acid and an organic acid teaching of Torek et al with Kropewnicki's wet etch chemistry, because it would improve the effectiveness of the wet etch solution as taught by Torek et al, column 2, lines 1-25.

Regarding claim 35, Kropewnicki et al., discloses wherein the hydrogen is provided from a hydrogen source selected from a group consisting of  $H_2$ ,  $NH_3$ , and  $CH_4$  (col. 6, lines 48-65 and col. 11, lines 1-10).

6. Claims 36-39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kropewnicki et al ( US Pat 6,440,864) and Torek et al (U.S. Pat 6,562,726) as applied to claim 30 as above, and further in view of Hillyer et al (U.S. Pat 6,613,681) ("Hillyer").

Kropewnicki et al do not disclose wherein a mixture of gases includes at least 50% hydrogen.

Regarding claim 36, Hillyer discloses removing a photoresist layer 20 using a plasma wherein a mixture of gases includes at least 50% hydrogen (col. 4, lines 4-53 and Fig. 45). At the time of the invention was made, it would have been obvious to a person of ordinary skill in the art to combine the combination of high percentage of

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hydrogen in the mixture teaching of Hillyer with Kropewnicki's mixture, because it would inhibit oxidation of the metal as taught by Hillyer, column 4, lines 23-28.

Regarding claims 37-39, Hillyer discloses wherein the mixture of gases comprises nitrogen and nitrogen (col. 4, lines 4-53 and Fig. 45).

7. Claims 61-68 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kropewnicki et al ( US Pat 6,440,864) in view of Hillyer et al (U.S. Pat 6,613,681) ("Hillyer").

Regarding claim 61, Kropewnicki et al., Figs. 1-6, and related text on col. 1-14 which discloses a method of fabricating an electronic device formed on a semiconductor wafer 35, comprising the steps of: forming a layer of a first material 45 in a fixed position relative to the wafer 35 (col. 5, lines 60-67 and Fig. 1 A); forming a photoresist layer 50 in a fixed position relative to the layer of the first material 45 has a dielectric constant less than 3.6 (col. 3, lines 10-55 and Fig. 1 A); forming at least one void 55 through the layer of the first material 45 in response to the photoresist layer 50 (col. 3, lines 35-55 and Fig. 1B); and subjecting the semiconductor wafer 35 to a plasma which incorporates a gas which includes a diluent and hydrogen so as to remove the photoresist layer 50 (col. 6, lines 10-65)

Kropewnicki et al do not disclose a gas which includes at least 50% hydrogen.

Regarding claim 61, Hillyer discloses removing a photoresist layer 20 using a plasma which incorporates a gas which includes a diluent and at least 50% hydrogen (col. 4, lines 4-53 and Fig. 45). At the time of the invention was made, it would have been obvious to a person of ordinary skill in the art to combine the combination of high

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percentage of hydrogen in the mixture teaching of Hillyer with Kropewnicki's mixture, because it would inhibit oxidation of the metal as taught by Hillyer, column 4, lines 23-28.

Regarding claim 62, Kropewnicki et al., discloses wherein the hydrogen is provided from a hydrogen source selected from a group consisting of H<sub>2</sub>, NH<sub>3</sub>, and CH<sub>4</sub> (col. 6, lines 48-65 and col. 11, lines 1-10).

Regarding claims 63-65, Hillyer discloses wherein the diluent comprises nitrogen and nitrogen (col. 4, lines 4-53 and Fig. 45).

Regarding claims 66-68, Kropewnicki et al., discloses wherein the first material 45 comprises carbon containing oxide, FSG which has dielectric constant less than 3.0 (col. 7, lines 52-67 and col. 8, lines 1-32).

***Allowable Subject Matter***

8. Claims 51-59 are allowed.

9. The following is an examiner's statement of reasons for allowance: The art of record does not disclose or anticipate the limitation in combination with other claim element nor would it be obvious to modify the art of record so as to removing the polymeric residue by subjecting the semiconductor wafer to a dry plasma having a mixture of at least 50% hydrogen, approximately 2-20% oxygen, and approximately 2-6% fluorine (claim 51); and removing the polymeric residue by subjecting the semiconductor wafer to a dry plasma having a mixture of at approximately 80% NH<sub>3</sub>, approximately 2-7% O<sub>2</sub>, approximately 10-15% N<sub>2</sub>, and approximately 2-6% CF<sub>4</sub> (in claim 52).



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Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

### ***Response to Arguments***

10. Applicant's arguments filed on 07/07/2004 have been fully considered but they are not persuasive. Applicants argue that Kropewnicki et al teaches away from the use of wet cleans. Examiner disagrees. Clearly in column 1, lines 44-45, Kropewnicki et al teaches removing the etched residue by using a wet cleaning process. Also, Applicants submit that it is not obvious to perform an annealing step after wet clean. Examiner disagrees. Annealing after a wet clean to evaporate/remove the etchant solution remaining on the surface of the wafer therefore reducing time for next conductor depositing step, and also eliminating contamination the wafer.

In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, clearly in column

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4, lines 20-67, and columns 5-7, Torek et al teaches a suitable wet processing method to improve the effectiveness of the wet etch solution.

***Conclusion***

11. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).


A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Quoc Hoang whose telephone number is (571) 272-1780. The examiner can normally be reached on Monday-Friday from 8.00 AM to 5.00 PM.

If attempt to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nelms can be reached on (571) 272-1787. The fax phone numbers of the organization where this application or proceeding is assigned are (703) 872-9306 for regular communications and (703) 872-9306 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

  
Quoc Hoang  
Patent examiner/AU 2818

  
David Nelms  
Supervisory Patent Examiner  
Technology Center 2800